## AMENDMENTS TO THE SPECIFICATION

Please replace the following paragraphs:

[0002] The present invention relates to a combustion control device and method for an engine, and more particularly to a combustion control device and method for an engine, which is capable of realizing a premix combustion that can sufficiently decrease the quantity of NOx (Nitrogen Oxides) and smoke in a wider operation region.

[0003] In the conventional diesel engines, the combustion has been typically conducted by injecting fuel in the vicinity of the compression top dead center (TDC) of a piston when the temperature and pressure inside the cylinder (inside the combustion chamber) were high.

[0014] Furthermore, the EGR (Exhaust Gas Recirculation (Recirculator)) by which exhaust gases are returned into the combustion chamber is effective for reducing the quantity of NOx, but if the EGR ratio in the normal combustion is increased, then air deficiency occurs and smoke is generated. Therefore, in the conventional two-stage injection system, it was necessary to control the EGR ratio. As a result, a certain quantity of NOx was also emitted. In this case, smoke and NOx are purified in after-treatment devices, but such a procedure increases fuel consumption and cost.

[0015] Further, even in the case of premix combustion using the above-mentioned single-stage ignition, if the EGR ratio was increased, the concentration of oxygen dropped and a misfire could even more easily occur [[even easier]]. For this reason, a sufficient effect of reducing the emission of NOx by the EGR could not be obtained.

[0025] Furthermore, the present invention provides a combustion control device for an engine, comprising a fuel injection valve for injecting a fuel into a combustion chamber, ignition timing adjustment means for adjusting an ignition timing of a mixture inside the combustion chamber, and control means for controlling the fuel injection valve and the ignition timing adjustment means, wherein

the control means comprises as fuel injection modes at least:

a single-stage premix injection mode in which the fuel injection valve is controlled so as to execute one injection within the interval from an intake stroke to a

compression stroke when an engine operation state is in a region with a low revolution speed and a low load; and

a multistage premix [[combustion]] injection mode in which the fuel injection valve is controlled so as to execute at least a first injection conducted within the interval from an intake stroke to a compression stroke and a second injection conducted in the vicinity of a compression top dead center after the execution of the first injection, and the ignition timing adjustment means is controlled so that the mixture formed by a fuel injected by the first injection and second injection and an intake air or the like is ignited after the ignition end of the second injection, when the engine operation state is in a region with a higher revolution speed and a higher load than those of the region in which the single-stage premix [[combustion]] injection mode is executed.

[0026] Here, the control means may additionally comprise as the fuel injection mode a normal [[combustion]] injection mode in which the fuel injection valve is controlled so as to execute at least one injection in the vicinity of the compression top dead center when the engine operation state is in a region with a load higher than that of the region in which the multistage premix [[combustion]] injection mode is executed.

[0027] Further, the ignition timing adjustment means may comprise exhaust gas recirculation (EGR) system for circulating exhaust gas into the combustion chamber, and

the control means may control the fuel injection valve so as to decrease gradually an injection quantity of the first injection of the multistage premix [[combustion]] injection mode and to increase gradually an injection quantity of the second injection to a target injection quantity of the normal [[combustion]] injection mode, and may control the exhaust gas recirculation system so as to decrease gradually a return ratio of the exhaust gas according to the increase in the injection quantity of the second injection when a transition is made from the multistage premix [[combustion]] injection mode to the normal [[combustion]] injection mode.

[0043] The fuel control device mainly comprises an injector 9, the below-described ignition timing adjusting means for adjusting the ignition timing of a mixture inside a combustion chamber 10 and an ECU (control means) 26 for controlling the fuel injection quantity and fuel injection timing of the injector 9 and ignition timing

adjusting means. A specific feature of [[he]] the fuel injection method realized with this fuel control device is that the injection for premix combustion is separated into a plurality of stages (two stages in the present embodiment). In the present specification, this injection method will be called a multistage premix injection.

[0049] FIG. 2 shows the measurement results relating to a mean gas temperature in cylinder, Tmean (K), heat generation ratio, ROHR (Rate of Heat Release) (J/°C.A.), and pressure in a cylinder, Pcyl (MPa), obtained when a single-stage premix injection was conducted as described in the aforesaid Japanese Patent Applications Laid-open Nos. H9-112325 and H10-331690 and when a multistage (two-stage) premix injection was conducted. Further, FIG. 3 shows the measurement results relating to the emitted quantities, (g/kWh), of NOx, THC (total Hc or Total HydroCarbon), and CO (Carbon Monoxide), and fuel consumption ratio, BSFC (Break Specific Fuel Consumption) (g/kWh), obtained in the same modes.

[0051] Furthermore, dot lines ② in the figures show the measurement results obtained with the two-stage premix injection; the injection timing of the first injection was about -30° ATDC (After Top Dead Center) and that of the second injection was about TDC (0° ATDC). Furthermore, the injection quantity of the first injection was set to 85% (28 $mm^3$/st) of the total injection quantity, and the injection quantity of the second injection was set to remaining 15% (5 $mm^3$/st). In the test, the adjustment of ignition timing with the EGR device 19 was not conducted.

[0054] Furthermore, in the two-stage premix injection ②, the fuel combustion [[ration]] ratio BSFC was also greatly improved by comparison with that of the single-stage premix injection ①, and the quantity of emitted CO and THC was also somewhat reduced.

[0060] The concentration of smoke in exhaust gases obtained when the ignition timing was thus adjusted was 0.88 (FSN) (Filter Smoke Number), and this value was sufficiently small by comparison with that obtained with the single-stage premix injection ① and the two-stage premix injection ② in which no adjustment of ignition timing was conducted, those results being shown in FIG. 2. In other words, it was confirmed that smoke could be reduced by conducting premix combustion of the second injection I2. Furthermore, it was also found that the emitted quantities of NOx, CO, and THC were also further reduced by comparison with two-stage premix

injection ② in which no adjustment of ignition timing was conducted (those results are shown in FIG. 2).

[0075] The second mode is a multistage (two-stage) premix [[combustion]] injection mode representing a specific feature of the present invention. In this mode, the injector 9 is controlled so as to execute the first injection conducted within the interval from the intake stroke to the compression stroke and the second injection conducted close to the compression top dead center after the execution of the first injection, and the EGR unit 19 is controlled so that the mixture formed by the intake air and the fuel injected by the first injection and the second injection is ignited after the completion of the second injection. This mode is executed when the engine operation conditions are in a region with a revolution speed and load higher than those of the region in which the single-stage premix [[combustion]] injection mode is executed.

[0076] The third mode is a normal [[combustion]] injection mode such as described in Japanese Patent Applications Laid-open Nos. 2000-145507 and 2001-207890. In this mode, the injector 9 is controlled so as to execute a small-quantity pilot injection conducted within an interval from the intake stroke to the compression stroke and the main injection conducted close to the compression top dead center. This mode is mainly executed when the engine operation state is in a region with a load higher than that of the region in which the multistage premix [[combustion]] injection mode is executed.

[0077] Thus, with the fuel control device of the present embodiment, it is possible to replace part of the region in which the engine conventionally operated in the normal [[combustion]] injection mode with the multistage premix [[combustion]] injection mode. As a result, the region in which the premix combustion is conducted can be expanded.

[0078] The transition from the multistage premix [[combustion]] injection mode to the normal [[combustion]] injection mode is conducted in the manner as follows.

[0079] Thus, the ECU 26 controls the injector 9 so that the injection quantity of the first injection is gradually decreased and the injection quantity of the second injection is gradually increased up to the target injection quantity of the normal

[[combustion]] injection mode. Furthermore, the EGR unit (exhaust gas recirculation system) 19 is controlled so as to reduce gradually the return ratio (EGR ratio) of the exhaust gas according to the increase in the injection quantity of the second injection. This is done because smoke is produced if the EGR ratio is increased in the normal [[combustion]] injection mode, as was mentioned hereinabove.

[0086] In the above-described embodiment, an example was considered in which three modes were provided as fuel injection modes. However, the present invention also can cover the entire operation range of the engine with the multistage premix [[combustion]] injection mode.

[0087] Moreover, the multistage premix [[combustion]] injection mode is not limited to two-stage injection, and premix injection comprising three or more stages can be also considered.